



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 10/807,537
Applicant: Shekel et al
Filed: March 23, 2004
For: METHOD AND APPARATUS FOR REAL-TIME
DYNAMIC CHEMICAL ANALYSIS
Art Unit 1763
Examiner : CULBERT, Robert P.
Docket No.: 06727/0201090-US0

14 August 2007

Commissioner for Patents
P.O.Box 1450
Alexandria VA 22313-1450

DECLARATION UNDER RULE 132

Sir:

1. I am a named co-inventor of the invention disclosed and claimed in the above-identified application. I am also a principal owner of the assignee, Nira Sciences Ltd.
2. I have a Ph.D. in chemistry from the University of Basel, Switzerland. I have worked in the field of near infra red spectroscopy for more than 20 years.
3. I believe that the method for etch rate monitoring disclosed and claimed in the application where etch rate is correlated directly with at least one optical property obtainable from spectroscopic results is novel and non-obvious. More specifically, the prior art fails to teach or suggest a method for etch rate determination which does not require determining the concentrations of the species in the etchant solution.

4. Moreover, I hereby confirm that attempting to monitor etch rate by spectroscopically monitoring the concentration of etchant species in a sample solution would not allow for monitoring of etch rate.

5. Under my direction and control, the following experiments were conducted in support of the statements in paragraphs 3 and 4 above.

A. As shown in Fig. 1 attached, the HF concentration of a series of HF solutions was measured by titration (y-axis) and by near infrared (NIR) spectroscopy (x-axis), the latter based on a calibrated data set of spectra of known HF concentrations. As shown in the Figure, the correlation was excellent and accords well with Thompson et al, a reference cited in the Office Action, dated March 27, 2007, issued against the present application.

B. In Fig. 2 attached, etch rate (ER) as determined by thickness measurement is presented on the y-axis while etch rate (ER) determined by NIR spectroscopy is presented on the x-axis. As can be seen, there is a poor correlation between the etch rate determined by thickness measurements (i.e. experimentally) and etch rates determined using NIR spectroscopy. The spectroscopically determined etch rates were determined using multiple linear regression (MLR) of HF concentration measurements made at discrete wavelengths as in Fig.1 and as in Thompson et al. In view of the good correlation in Fig. 1, it would have been expected that, based on this model, there would be a good correlation in Fig. 2 as well. Such was not the case.

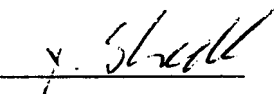
C. In Fig. 3 attached, etch rate as determined by NIR spectroscopy according to the method recited in amended claim 14 (x-axis) correlates very well with actual etch rate as determined by laboratory thickness measurements (y-axis). In this Figure, determination of etch rate using NIR spectroscopy was made without knowing the exact concentrations of the etchant species in the etchant solution. It did however require amassing a spectral database where spectral features and properties across an entire spectral range were correlated against laboratory determined etch rates. The algorithm used was a principal component analysis (PCA) algorithm.

6. I have reviewed the prior art cited against the above application in the Office Action dated March 27, 2007. The Brause and Thompson citations disclose measuring the concentrations of the species in an etchant solution. As shown in the data presented in paragraph 5 above,

knowing the concentrations of the etchant species will not necessarily allow one to monitor etch rate. However, as shown and discussed in conjunction with Fig. 3 above, using a spectral database collected over a wide variety of conditions, including aging conditions, can be correlated with actual etch rate.

7. I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the application or any patent issuing thereon.

Respectfully submitted,

Signature: 

Printed Name: Yehuda Shekel

Date: August, 8th, 2007

Attachment:

Figs. 1-3 on a single sheet

Fig. 1: %HF NIR predicted vs. % HF Lab tests

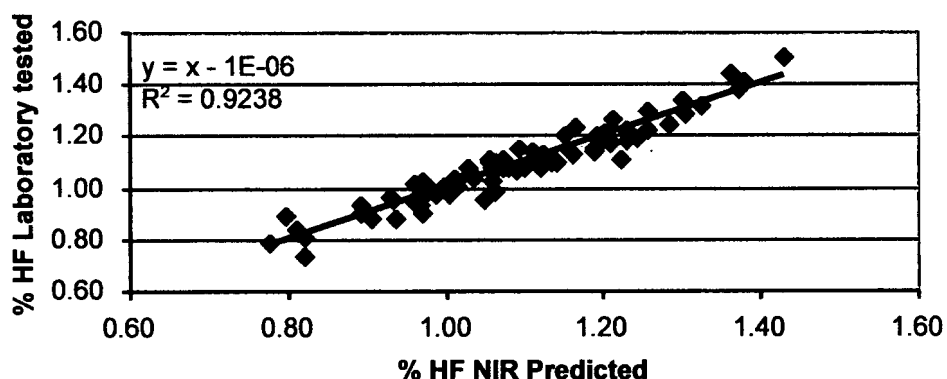


Fig. 2: ER NIR predicted by MLR (HF modeling) vs. ER TW

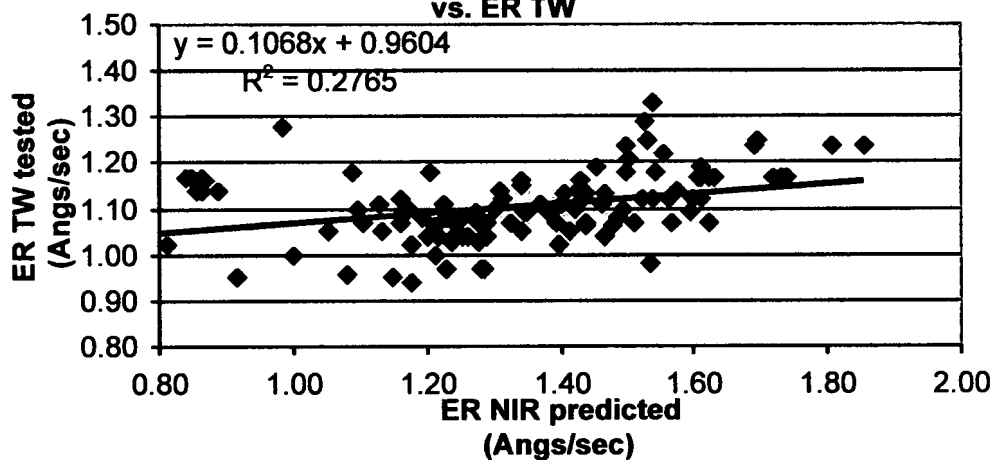


Fig. 3: ER NIR predicted vs. ER TW tested

